

around Tabo village and on rocky slopes.

**Rufous-breasted accentor *Prunella strophciata* (Prunellidae):** Small flocks, common in fields around Tabo village. Altogether 5 birds seen.

**Tibetan snowfinch *Montifringilla adamsi* (Passerinae):** Two birds once seen feeding on the ground in the vicinity of Tabo village.

The birds were identified using Ali and Ripley (1983, 1989) and Porter *et al.* (1981).

March 23, 2001

ARUN P. SINGH

Entomology Department,  
Forest Research Institute,  
Dehra Dun, Uttaranchal, India.  
Email: singhap@icfre.up.nic.in

Permanent Address: c/o Col. R.S. Verma  
25-D, New Cantt. Rd,  
Hathi Barkala, Dehra Dun,  
Uttaranchal 248 001, India.

#### REFERENCES

- ALI, S. & S.D. RIPLEY (1983): A Pictorial Guide to the Birds of the Indian subcontinent. Bombay Natural History Society, Bombay.
- ALI, S. & S.D. RIPLEY (1989): Compact Handbook of the Birds of India and Pakistan, together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. 2nd edn, Oxford University Press, Delhi, pp. 737 + 104 plates.
- ASWAL, B.S. & P.N. MEHROTRA (1994): Flora of Lahaul-Spiti. Bishan Singh and Mahendra Pal Singh Publ. Dehra Dun.
- KAPOOR, K.S. & S. BHAGAT (1990): Resource potentials of Spiti: Cold mountain desert of Himachal Pradesh. *Annals of Arid Zone* 29: 243 -250.
- NEGI, J.P. (1985): Developmental perspectives in the Himalayan mountain desert of Spiti (Himachal Pradesh). Greening of Mountain Deserts. 72nd Session of INSA, Lucknow.
- PORTER, R.F., S. CHRISTENSEN, I. WILLIS & B.P. NEILSEN (1981): Flight identification of European raptors. 3rd edn. Poyser, Carlton.
- SINGH, R.P. & M.K. GUPTA (1990): Soil and vegetation study of Lahaul-Spiti cold desert of western Himalayas. *Indian Forester* 116: 785-790.

### 38. OCCURRENCE OF *TRIOPS GRANARIUS* (LUCAS), CRUSTACEA: NOTOSTRACA, FROM MADURAI, TAMIL NADU

(With one text-figure)

Tadpole shrimps, considered as 'living fossils', are widely distributed in all continents except Antarctica (Whitehead 1990). The genus *Triops* has been reported from isolated localities in the Indian subcontinent (Packard 1871; Sars 1901; Kemp 1911; Walton 1911; Gurney 1925; Chacko 1950; Tiwari 1951, 1952; Longhurst 1955; Shanbhag and Inamdar 1968; Sanjeeva Raj 1971; Ghate and Shetty 1997). It is known for its intraspecific morphological variations that is, within the same species in different localities, hence it has been described under different specific names, adding to the taxonomic confusion within the genus.

This study reports the occurrence of *Triops* from Madurai, Tamil Nadu. About 20 mature

live tadpole shrimps were collected near Thirumangalam (near Latibos India), Madurai (9° 58' N, 78° 10' E) during our survey on fairy shrimps in October 1996. Sizes of both male and female range from 1.8 to 3.9 cm. Species of this group have an elongate body, oval carapace covering the head, thorax and a variable portion of the abdomen (Fig. 1a). Shape varies from round to triangular, with rounded anterior margin between eyes, whereas the posterior margin is straight and slightly emarginated. Lateral edges of carapace bear small spines and edge of rear notch has short prominent spines. Sulcus is triangular with rounded emargination and wide base. Head bears an eye on the dorsal surface and reduced second antennae. The dorsal

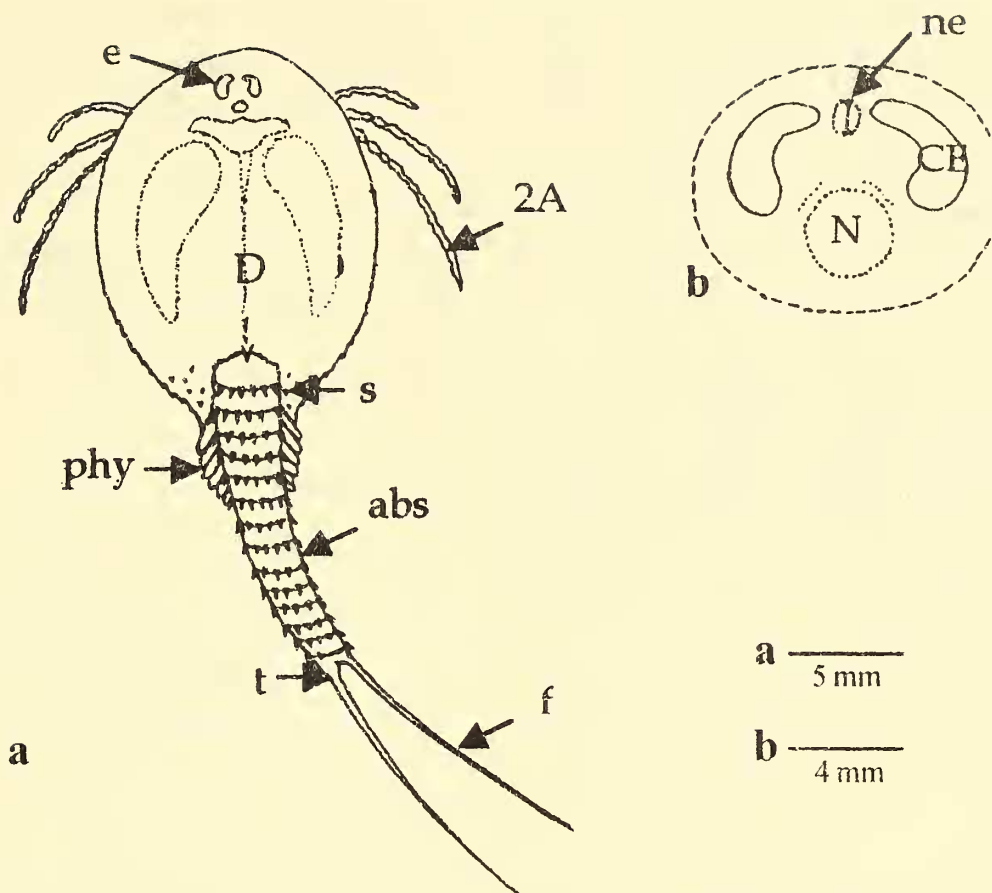


Fig. 1a-b: a. Diagrammatic representation of the notostracan *Triops granarius* (Lucas):  
 b. Higher magnification of the dorsal eye

D - dorsal shield, abs - abdominal segment, t - telson, 2A - second antennae,  
 CE - compound eye, e - dorsal eye, f - furca, ne - naupliar eye, N - neck organ, phy - phyllopods, s - sulcus

eye possesses a reduced naupliar eye and a neck organ between the kidney-shaped compound eyes (Fig. 1b).

Abdomen has 35 movable somites, about 15 of which are exposed beyond the carapace. Nine apodal segments possess prominent chitinised brown dorsal and ventral spines. Telson is broader and consists of 4 dorso-medial spines, 3 strong setal spines and small denticles, 6 posterior marginal spines, 4-5 lateral spines and 5 furcal spines. Furca is slender and longer than carapace, with serrated spines. Eleven pairs of thoracic appendages, namely phyllopods, one on each of the eleven body segments are used for locomotion. First pair consists of two segments separated by a joint chitinous cuticle, which allows bending of one segment upon the other; they have a sensory function and are used for capture of prey. There are 50 pairs of legs, gradually decreasing in size from the genital

apertures; they are known as "abdominal appendages" and are used both for feeding and locomotion. Reproductive mode varies on a geographical basis, northern forms being hermaphroditic while southern populations are bisexual. In general, males are rare in the genus *Triops*. Gurney (1925) reported males outnumbering females in his collection (= *Apus asiaticus*) and Tiwari (1951) also agrees with Gurney's findings.

Notostracans are detritus feeders and predators. In the present study, it was collected along with anostracans and conchostracans. *T. orientalis* appears to be omnivorous and it has been observed to feed on bacteria, protozoa, *Daphnia*, copepods, small oligochaetes and also on *Streptocephalus* and Leptestheriid forms (Shanbhag and Inamdar 1968). *Triops* exhibits cannibalism, and even a small individual can easily eat a larger one. *Triops* is recorded as a



pest of rice cultivation in different parts of the world such as Kashmir (Kemp 1911, Walton 1911), Spain (Font de Mora 1923), California (Rosenberg 1946) and Japan (Takahashi 1977). Fryer (1987) reported natives of the Federal District, Mexico using tadpole shrimps as food.

The genus is well known for its discontinuous distribution. Linder (1952) and Longhurst (1955) recognized only about 11 species, of which seven have wide geographic distribution. This classification has long been accepted 'even attaining the status of dogma' (Sassaman *et al.* 1997).

According to our study and other published records, only two species of *Triops*,

*T. cancriformis* (Bosc) and *T. granarius* (Lucas) are known to occur in the Indian subcontinent. The former was reported in northern localities and the latter in the rest of India, particularly in the southern parts.

The authors are deeply indebted to the late Mr. Anthony Basil, Technical Officer, Madurai Kamaraj University, Madurai for accompanying them during the collections.

July 18, 2001

C.S. VELU

\*N. MUNUSWAMY

Department of Zoology,  
University of Madras, Guindy Campus,  
Chennai 600 025, Tamil Nadu, India.

\*Email: nmunuswamy@yahoo.com

## REFERENCES

- CHACKO, P.I. (1950): Occurrence of the fairy shrimp *Apus* in a temple tank in Tirunelveli District, Madras. *J. Bombay nat. Hist. Soc.* 49: 571.
- FONT DE MORA, R. (1923): Un destructor de planteles de arroz. *Bol. Soc. Esp. Hist. Nat. Madrid.* 23: 313.
- FRYER, G. (1987): A new classification of the branchiopod Crustacea. *Zool. J. Linn. Soc.* 91: 357-383.
- GHATE, H.V. & NAGARAJ SHETTY (1997): Record of *Triops* (Crustacea: Branchiopoda: Notostraca) from Pune, Maharashtra. *J. Bombay nat. Hist. Soc.* 94: 588-589.
- GURNEY, R. (1925): Some Asiatic species of *Apus*. *Rec. Indian Mus.* 27: 439-442.
- KEMP, S. (1911): Notes on the occurrence of *Apus* in Eastern Asia. II. Notes on Major Walton's specimens and on others from Kashmir with a list of previous records from Eastern Asia. *Rec. Indian Mus.* 6: 353-357.
- LINDER, F. (1952): Contributions to the morphology and taxonomy of the Branchiopoda Notostraca, with special reference to the North American Species. *Proc. U.S. Nat. Mus.* 102: 1-69.
- LONGHURST, A.R. (1955): A review of the Notostraca. *Bull. Brit. Mus. Nat. Hist. (Zool.)* 3: 3-57.
- PACKARD, A.S. (1871): Preliminary notice of new North American phyllopoda. *Am. J. Sci. Arts. Ser.* 3(2): 108-113.
- ROSENBERG, L.E. (1946): Fairy shrimps in California. *Science* 104: 111.
- SANJEEVA RAJ, P.J. (1971): *Triops granarius* (Lucas) (Crustacea: Branchiopoda) from Tamil Nadu and a review of the species from India. *J. Bombay nat. Hist. Soc.* 68: 161-168.
- SARS, G.O. (1901): On the crustacean fauna of Central Asia. *Ann. Mus. St. Petersburg* 6: 130-164.
- SASSAMAN, C., M.A. SIMOVICH & M. FUGATE (1997): Reproductive isolation and genetic differentiation in North American species of *Triops* (Crustacea: Branchiopoda: Notostraca). *Hydrobiologia* 359: 125-147.
- SHANBHAG, S.V. & N.B. INAMDAR (1968): On the occurrence of *Triops mavliensis* (Tiwari), Notostraca (Crustacea) in the Okhamandal region of Saurashtra (India). *J. Bombay nat. Hist. Soc.* 65: 408-417.
- TAKAHASHI, F. (1977): *Triops* spp. (Notostraca: Triopsidae) for the biological control agents of weeds in rice paddies in Japan. *Entomophaga* 22: 351-357.
- TIWARI, K.K. (1951): Indian species of the genus *Apus* (Crustacea: Branchiopoda) with description of two new species. *Rec. Indian Mus.* XLIX: 197-205.
- TIWARI, K.K. (1952): On sex ratio and variability of Apodal segments in *Apus* (Phyllopoda, Crustacea). *J. Bombay nat. Hist. Soc.* 52: 641-644.
- WALTON, S.J. (1911): Notes on the occurrence of *Apus* in Eastern Asia. I. On the occurrence of *Apus* Latreille, in the United Provinces of India. *Rec. Indian Mus.* 6: 351-352.
- WHITEHEAD, P. (1990): Systematics: an endangered species. *Syst. Zool.* 39: 179-184.